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PAN GEODETIC COMMITTEE SYMPOSIUM ON POLISH COMPUTERS

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FOREWORD

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PAN GEODETIC COMMITTEE SYMPOSIUM ON POLISH COMPUTERS

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On 18 June 1960 a symposium of the PAN Geodetic Committee took place
in the geodetic pavilion of the Mining-Metallurgy Academy on the subject
of the construction and exploitation of PARK (Relay Computer for Cracovian
Calculations) and PARC (Relay Computer for Calculations on Multi-dimension
Series) machines.
    The meeting was opened by the President of the PAN Geodetic
Committee, Professor M. Odlanicki, who presented the two basic aims of
the symposium:
    1) evaluation of the purposefulness of projects undertaken to
date,
    2) consideration of the direction of further scientific research
and engineering design work connected with the construction and exploi-
tation of PARK (PARF) and PARC calculating machines.
    Professor Odlanicki asked PAN Geodetic Committee members Professor
J. Gomoliszewski to preside over the discussions, and Supernumerary
Professor B. Dulian to be vice-chairman at the symposium. Senior Assis-
tant Graduate Engineer B. Ney was designated secretary of the symposium.
    The program of the symposium included four reports, a discussion,
and exhibitions of PARK (PARF) and PARC calculating machines.
    Professor Doctor Engineer Tadeusz Kochmanski presented a general
report on the scientific and construction work carried out up to the
present, and on the program of further work connected with the construc-
tion and exploitation of PARF and PARC calculating machines.
    The author outlined the history of the first stage of work, which
began in 1948 with the submittal of his own idea of the "Poland" machine,
based on cracovian and cracovian-derived calculations (nuclear algebra,
matrix algebra). Next to be developed was PARK, an automatic relay device
making use of the factoring / ? / machine and finally the PARF now used
by the Geodetics Computations Laboratory of the AGH (Akademia Gorniczo-
Hutnicza — Mining-Metallurgy Academy). The PARF grew out of the PARK

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after the latter had been greatly simplified. The latest PARF device
having been completely automated is now suitable for use in small compu-
tational centers, mainly for linear problems.

The second stage of work consisted of the construction of an auto-
matic multiplier relying solely on relays (PARC device). The main construc-
tion of PARC is ready; however, the machine still lacks perforating-trans-
mitting sets and an impulsator. The activization of the latter requires
foreign currency and a considerable amount of experts' time. In order to
avoid importation, work was begun on plans for the local production of
transmitters, simpler than the Siemens factory sets and adapted for the
needs of the PARC. This is to lead to the start of production of specia-
lized digital machinery, which is considerably cheaper than electronic
machinery, but capable of comparable general efficiency in specific kinds
of calculations. The existing machinery is to become the nucleus of a
local computational center working for the Mining-Metallurgy Academy and
other Cracow institutions of higher learning and industry, especially
mining and metallurgy. In addition, the center would work out the theory
and practical computational methods.

Mgr Gerard Kudelski gave a detailed description of the PARK and
PARC machines.

Each of these machines is made up of three fundamental parts: the
arithmetic unit, memory, and control mechanism. In the PARK computer,
the factoring $\boxed{?}$ machine, consisting of a setting mechanism, three
counters, and a multiplicand and product register, serves as the arith-
metic unit; although it does not divide directly, the latter may be
done with the help of an appropriate program. The project of an airth-
metic unit for the PARC machine was developed on the basis of the ARITMA
type multiplying machine and realized with the aid of B1 relays, which
permitted the machine to attain the speed of 26 additions per second. By
equipping the machine with standard exchangeable parts, immediate repair
of the machine is possible. The number of standard elements of the arith-
metic unit, so-called central counters, is equal to the number of decimal
digits in the arithmetic unit.

The memory is composed of three exchangeable parts, each of which
consists of a transmitter which reads values written on teletype tape, and
a perforator which automatically perforates the tape. The transmitters
consist of electromagnets which move the tape, and five reading brushes
which transform the tape perforations into electrical impulses in the
appropriate circuit. In addition to the electromagnet moving the tape,
the perforator has five electromagnets which, when connected, cause holes
to be punched in the tape.

To control the PARK machine, successive instructions of the program
under execution are given to it in the form of patch panel connections.
In the course of carrying out the computations, the instructions are fed
cyclically from various selectors $\boxed{?}$, the process being synchronized
by the impulsator. In the PARC machine, all the relays are divided into
two groups which control one another in synchronization with the impulsator.

Presently completed is one segment of the PARC unit containing a built-in program for automatic squaring of the Cracovian. It is so designed as to enable a symmetrical Cracovian to be broken down into canonical factors semi-automatically. Arrays of ordinary equations with one hundred unknowns (the non-zero coefficients of which are grouped around the diagonal) will take a few hours to solve. Mgr. Jerzy Kordylewski gave a lecture on the uses made up to the present time of the PARK (PARF) machine.

The PARK machine activated in 1957 was given two tasks: to investigate specific elements of Polish production (relays, selectors $[?]$, and others) and to select the best of them for further construction work, and to choose certain optimal sub-routines essential for the majority of typical calculations.

In the first stage of the use of the PARK machine the following computations were effected:

1) the solution of algebraic equations of higher degrees; seventy-two fifth-degree equations of the form

$$x^5 - a_3 x^3 + a_1 x - a_0 = 0$$

and five seventh-degree equations of the form

$$x^7 - a_5 x^5 + a_3 x^3 - a_2 x^2 + a_0 = 0$$

were solved by the test method;

2) the repeated, successive multiplication and addition of Cracovians with several hundred elements.

Later, the machine was modified to simplify it and eliminate unreliable elements. The new machine, considerably simpler in construction and maintenance, although theoretically less universal, was named PARF and was used for the following computations:

1) the solution of two sets of linear equations with seven unknowns and two sets with eight unknowns (undesignated solution);

2) multiplication of two seven-row Cracovians with eight and 336 columns,

3) a calculation encompassing third-difference interpolations for 222 arguments and numerical integration for 222 arguments (plus double integration of 37 arguments),

4) the calculation of the inverse of the Cracovian root with 52 columns,

5) the solution of five sets of second-degree algebraic equations with seven to twelve unknowns reduced to $n - 1$ linear equations with one parameter and one second-degree equation.

The current PARF model possesses built-in sub-routines, automatically carried out:

1) the basic sub-routine, calculation of $\sum a_i b_i + c$

2) the product sub-routine, calculation of $\sum a_i b_i$

3) the summation sub-routine, calculation of $\sum c_i$

4) the polynomial sub-routine, calculation of $\sum a_i x^i$

These routines enable all problems having Cracovian formulae, especially linear equations, to be solved semi-automatically; they also permit higher degree algebraic equations to be solved.

Supernumerary Professor Dr Engr Henryk Gorecki delivered a lecture entitled "The Evaluation of the Purposefulness of Construction of the PARK (PARF) and PARC Computing Machines from the Point of View of Computation and Automation Demand."

In the first part of the lecture the author justified the priority for specialized machinery by analyzing seven basic factors influencing the development of digital machines in a specialized or universal direction.

From this analysis it follows that in our situation, the specialized direction is the right one for the following reasons:

    1) the fundamental problems of national industry give priority to specialized machines; the following problems are involved:

        a) geodetics problems (equalizing the nation-wide network),

        b) problems in geometrical optics,

        c) transportation problems,

        d) problems of uniform distribution of the national power network load,

        e) making mathematical tables,

        f) calculations concerned with the determination of crystal structures for the needs of technology;

    2) the costs of construction, exploitation, and conservation of specialized machines are much lower than those for universal machines;

    3) the training of personnel can be effected considerably faster and easier on specialized machines;

    4) specialized machines are easier to maintain and more reliable in operation;

    5) programming -- very complicated and difficult for universal machines -- is relatively simple for specialized machines;

    6) small specialized machines are better adapted for direct industrial control.

From the above, it follows that under the conditions existing in Poland the development of computations automation can be expected to take the direction of highly differentiated, specialized machinery; this will enable the satisfaction of a very wide range of industrial and scientific needs at relatively small costs.

The second part of Professor Gorecki's lecture was concerned with the development of the Cracow Computational Center, with particular emphasis on the justification of reliance upon specialized machines. The speaker saw great possibilities and needs for further development of the Center for the purpose of satisfying the scientific needs of AGH and for solving industrial problems; he also considered the results obtained under difficult conditions as satisfactory and promising for the future.

Prof Dr Engr Stefan Hausbrandt, through the intermediary of Mgr Engr Jerzy Gazdzicki, presented his comments on Mgr Kordylewski's address.

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"The problem of automating computations," writes Prof Hausbrandt, "is one of the more important problems of contemporary geodetics, which is faced with large-scale, often very time-consuming, computational tasks in both its scientific and technological capacities. For this reason the construction projects at the Cracow center merit special attention."

The author suggests that a study be undertaken on the suitability of using a PARF subroutine of the type $aibi+c$ for various kinds of coordinate transformations. The attitude of designers of PARF, favoring simplicity of construction while retaining the automation of the computing processes for certain typical subroutines, should be considered justified. PARF-type machines will find wide applications, especially if sufficient care is taken to ensure their operational reliability and the lowest possible cost in eventual mass production.

Eleven of the symposium participants took part in the discussion, some of them on more than one occasion.

The discussion was centered around the following questions:

1) evaluation of the appropriateness of the research and construction work done to date;

The debaters spoke approvingly of the results of the construction work undertaken at the Geodetics Computation Laboratory AGH. The choice of specialized relay machines, not very fast in operation but adapted to automatic solution of specific kinds of relatively small computations, should be considered justified in the light of the present economic situation of the country and the financial and staff limitations of the Center.

2) the problems connected with the exploitation of the PARF computer and the present state of the Center;

A need of re-examining the possibilities of using the computer for the solution of geodetic problems not thus far tackled in this manner, e.g., transformations of coordinates, geodetic astronomy problems, time service problems, reductions, etc., was acknowledged. Connected with this is the necessity of further improving the computer by adding further built-in subroutines to it. As a consequence, an optimal model of this type of computer should emerge which is suitable for mass production. For the realization of these projects, improvements in the equipping and financing of the Center are necessary.

3) the directions to follow in future research and construction projects.

On the basis of the analysis made, the trend towards specialized relay computers should be considered dominant also in planning for the Center. Thus PARC, a faster and more complex computer than the PARF, should be created, with much care being given to its operational reliability. Production in Poland of elements presently imported (memory elements) should be envisaged and set up. While working on relay computers, development of electronic devices abroad and in other Polish centers should be closely followed. The experience gained with relay computers will be applicable, under favorable conditions, to starting electronic computer production.

The following description of the purposes of the Center should be considered just:

a) laying the plans for new installations and elements of computers,

b) training personnel for construction and use of automatic computers,

c) use of automatic computers coupled with working computational problems for research and industrial needs,

d) scientific responsibility for computers designed at the Center but built elsewhere,

e) systematic study of progress in the automation of computational processes and in the construction of various computers in foreign and Polish centers.

At the close of debate at the symposium, summarized by the undersigned, the participants unanimously expressed approval of the projects undertaken to date; they also expressed a positive opinion about plans for future scientific and construction work, simultaneously authorizing the symposium chairman to forward this resolution to the Presidium of the PAN Geodetics Committee.

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